4.4 Radiated Spurious Emissions: EIRP Data (FCC §25.202(f))

Radiated spurious emissions must comply with the requirements of §25.202 (f) of FCC. The limits for the spurious emissions are as follows:

FCC Part 25.202(f):

Radiated spurious emissions must comply with the requirements of §25.202(f). The limits for the spurious emissions are as follows:

The mean power of emissions shall be attenuated below the mean output power of the transmitter in accordance with the following schedule:

(1) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: 25 dB;

(2) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: 35 dB;

(3) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 250 percent of the authorized bandwidth: An amount equal to 43 dB plus 10 times the logarithm (to the base 10) of the transmitter power in watts;

Based on the power measured, the limit for emissions removed from the center frequency by more than 250% of the authorized bandwidth will be:

$$\text{Limit(dBm)} = 34\text{(dBm)} - (43 + 10\text{Log}(2.51)) = -13\text{dBm}$$

This section covers emissions detected at more than 250% removed from the authorized bandwidth.

4.4.1 Test Procedure

The EUT was placed on motorized turntable for radiated testing on a 3-meter open field test site. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Receiving antennas were mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna was varied between 1 and 4 meters. The peripherals were placed on the table in accordance with ANSI C63.4-2003. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured.

Where emissions were detected, the EIRP levels were determined using the method of signal substitution. The measurement bandwidth used was set to 3kHz. A 1.25dB correction was added to the spectrum analyzer signal level for referencing to the specification bandwidth of 4kHz. The actual EIRP level was calculated as follows.

EIRP(dBm) = Signal generator substitution level(dBm) + Antenna Gain(dBi)

4.4.2 Test Results

The frequency range of 30 MHz to 16.5 GHz was measured and the data presented below.

Table 5. Radiated Emissions <1000MHz Test Data Sheet

Frequency (MHz)	Polarity H/V	Az Deg	Ant. Hght (m)	SA Level (QP) (dBµV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Corr. Level (dBµV/m)	Corr. Level (µV/m)	Limit (µV/m)	Margin (dB)
39.63	V	180.0	1.0	12.2	11.6	1.4	25.2	18.3	100.0	-14.8
62.04	V	90.0	1.0	11.4	9.6	1.7	22.7	13.7	100.0	-17.3
86.00	V	190.0	1.2	18.6	9.6	2.0	30.2	32.3	100.0	-9.8
108.52	V	270.0	1.4	9.9	10.8	2.2	22.9	13.9	150.0	-20.7
116.11	V	120.0	1.5	11.4	11.4	2.2	25.0	17.8	150.0	-18.5
149.75	V	190.0	1.4	7.0	12.6	2.4	22.0	12.6	150.0	-21.5
298.57	V	250.0	1.2	16.1	20.8	3.3	40.2	102.9	200.0	-5.8
300.00	V	270.0	2.0	10.4	14.1	3.4	27.9	24.7	200.0	-18.2
375.99	V	90.0	1.6	11.2	16.6	3.8	31.5	37.8	200.0	-14.5
394.44	V	180.0	2.0	5.8	16.5	3.8	26.2	20.3	200.0	-19.9
398.10	V	180.0	1.0	22.2	16.5	3.9	42.6	134.4	200.0	-3.5
467.21	V	180.0	2.0	4.0	17.1	4.3	25.3	18.5	200.0	-20.7
497.66	V	200.0	1.6	20.4	17.2	4.4	42.0	126.4	200.0	-4.0
796.25	V	90.0	2.7	7.2	21.3	6.2	34.8	54.7	200.0	-11.3
995.31	V	90.0	3.5	3.4	24.0	7.4	34.8	54.7	500.0	-19.2
39.63	H	240.0	1.0	11.1	11.6	1.4	24.1	16.1	100.0	-15.9
86.00	H	90.0	2.0	7.5	9.6	2.0	19.1	9.0	100.0	-20.9
108.52	H	270.0	2.5	9.4	10.8	2.2	22.4	13.1	150.0	-21.2
116.11	H	90.0	3.0	9.5	11.4	2.2	23.1	14.3	150.0	-20.4
149.75	H	45.0	2.0	9.5	12.6	2.4	24.5	16.8	150.0	-19.0
298.57	H	0.0	1.6	13.2	20.8	3.3	37.3	73.7	200.0	-8.7
300.000	H	190.0	3.8	10.7	14.1	3.4	28.2	25.6	200.0	-17.9
375.990	H	0.0	3.5	12.8	16.6	3.8	33.1	45.4	200.0	-12.9
394.435	H	0.0	3.0	5.5	16.5	3.8	25.9	19.6	200.0	-20.2
398.100	H	0.0	3.5	21.2	16.5	3.9	41.6	119.8	200.0	-4.5
467.210	H	0.0	2.5	5.2	17.1	4.3	26.5	21.2	200.0	-19.5
497.661	H	260.0	3.1	20.8	17.2	4.4	42.4	132.4	200.0	-3.6
796.249	H	250.0	1.6	9.8	21.3	6.2	37.4	73.8	200.0	-8.7
995.310	H	250.0	1.0	4.1	24.0	7.4	35.5	59.3	500.0	-18.5

Table 6. Radiated Emissions >1000MHz Test Data Sheet

Frequency (MHz)	Polarity H/V	Az Deg	Ant. Hght (m)	Spurious Level dBµV	Sub. Sig. Gen. Level dBm	Sub. Power Level dBm	Sub. Ant. Factor dB/m	Sub. Ant. Gain dBi	EIRP Level dBm	Limit dBm	Margin dB
1643.60	H	270.0	1.0	106.3	-2.0	-4.6	28.7	5.9	1.3	40.0	-38.7
3287.20	H	180.0	1.0	74.3	-22.2	-27.2	35.1	5.4	-21.7	-13.0	-8.7
4930.90	H	270.0	1.0	69.3	-23.3	-28.7	36.4	7.6	-21.1	-13.0	-8.1
6574.57	H	270.0	1.0	53.8	-35.4	-41.3	39.1	7.5	-33.8	-13.0	-20.8
8218.00	H	180.0	1.0	50.2	-30.6	-38.0	42.4	6.1	-31.9	-13.0	-18.9
9861.73	H	180.0	1.0	51.0	-29.6	-34.3	45.4	4.7	-29.7	-13.0	-16.7
11505.33	H	180.0	1.0	48.3	-23.9	-31.2	47.0	4.4	-26.7	-13.0	-13.7
13148.93	H	180.0	1.0	49.0	-22.4	-28.6	48.6	4.0	-24.6	-13.0	-11.6
14792.40	H	180.0	1.0	48.8	-15.6	-26.7	52.6	1.1	-25.6	-13.0	-12.6
16436.00	H	180.0	1.0	48.0	-12.0	-21.7	52.0	2.5	-19.1	-13.0	-6.1
1096.00	H	90.0	1.0	62.7	-35.9	-37.8	24.9	6.1	-31.7	-13.0	-18.7
1194.70	H	0.0	1.0	51.5	-59.0	-60.3	25.7	6.1	-54.2	-13.0	-41.2
1643.60	V	270.0	1.0	106.5	0.6	-2.2	28.7	5.9	3.7	40.0	-36.3
3287.20	V	270.0	1.0	78.1	-19.3	-24.1	35.1	5.4	-18.7	-13.0	-5.7
4930.90	V	190.0	1.0	71.0	-24.2	-29.7	36.4	7.6	-22.1	-13.0	-9.1
6574.57	V	290.0	1.0	55.1	-35.2	-41.0	39.1	7.5	-33.5	-13.0	-20.5
8218.00	V	180.0	1.0	49.3	-35.6	-43.0	42.4	6.1	-36.9	-13.0	-23.9
9861.73	V	250.0	1.0	58.1	-26.6	-31.5	45.4	4.7	-26.8	-13.0	-13.8
11505.33	V	180.0	1.0	48.7	-24.7	-32.0	47.0	4.4	-27.6	-13.0	-14.6
13148.93	V	180.0	1.0	48.0	-25.4	-31.5	48.6	4.0	-27.5	-13.0	-14.5
14792.40	V	180.0	1.0	48.3	-15.6	-26.7	52.6	1.1	-25.6	-13.0	-12.6
16436.00	V	180.0	1.0	48.2	-13.4	-23.2	52.0	2.5	-20.7	-13.0	-7.7
1096.00	V	270.0	1.0	54.8	-54.5	-56.5	24.9	6.1	-50.4	-13.0	-37.4
1194.70	V	190.0	1.0	51.3	-56.1	-57.5	25.7	6.1	-51.4	-13.0	-38.4
1393.67	V	45.0	1.0	51.8	-55.7	-57.3	27.1	6.0	-51.3	-13.0	-38.3

4.5 Radiated Spurious Emissions per FCC §25.216

FCC Part 25 limits the emissions from mobile earth stations for the protection of aeronautical radio navigation-satellite service. The EIRP density of spurious emissions which fall within the frequency range of 1559M to 1610MHz were measured in accordance with §25.216.

In accordance with §25.216(c) the EIRP density of emissions from mobile earth stations operating between 1610MHz and 1660.5MHz shall not exceed -70dBW/MHz, averaged over any 2ms active transmission interval, in the band 1559M – 1605MHz. The EIRP of discrete emissions of less than 700 Hz bandwidth from such stations shall not exceed -80 dBW, averaged over any 2ms active transmission interval, in the 1559M – 1605MHz band.

In accordance with §25.216(i) the peak e.i.r.p density of carrier-off state emissions from mobile earth stations manufactured more than six months after **Federal Register** publication of the rule changes adopted in FCC 03–283 with assigned uplink frequencies between 1 and 3 GHz shall not exceed -80 dBW/MHz in the 1559– 1610 MHz band averaged over any 2 millisecond active transmission interval.

4.5.1 Test Procedure

The output of the EUT was connected to the input of measurement receiver with a RMS detector and the capability of performing the measurements as specified in §25.216. The following was used to calculate the limit and the corrected emissions levels for obtaining the plots shown in Figure 71 through Figure 74.

For emissions from 1559M – 1605MHz:
Limit = -70dBW/MHz = -40dBm/MHz

For discrete emissions with bandwidths less than 700Hz from 1559M – 1605MHz
Limit = -80dBW = -50dBm

The receiver emissions levels were adjusted for correction factors as follows:

Emission Level = RXL + ATT
Where: RXL = Raw received level
ATT = Attenuator = 20dB

These correction factors were entered into the receiver as an offset so the obtained plots would display corrected data for comparison to the limit.

The receiver was then setup to scan the emissions in the frequency range of 1605M – 1610MHz as per §25.216(f). The same procedure used for the 1559M -1605MHz scan, as described above, was used. The limit for emissions appearing in the 1605M – 1610MHz is determined by the linear interpolation from -70dBW/MHz at 1605M to -10dBW/MHz at 1610MHz. Additionally, the emission levels were compared to the specification limit of §25.216(h). Under this section the limit is determined by linear interpolation from -70dBW/MHz at 1605MHz to -46dBW/MHz at 1610MHz.

4.5.2 Test Results

The following plot shows the maximum emissions detected with the band of 1559M – 1610MHz in both a standby and operating mode.

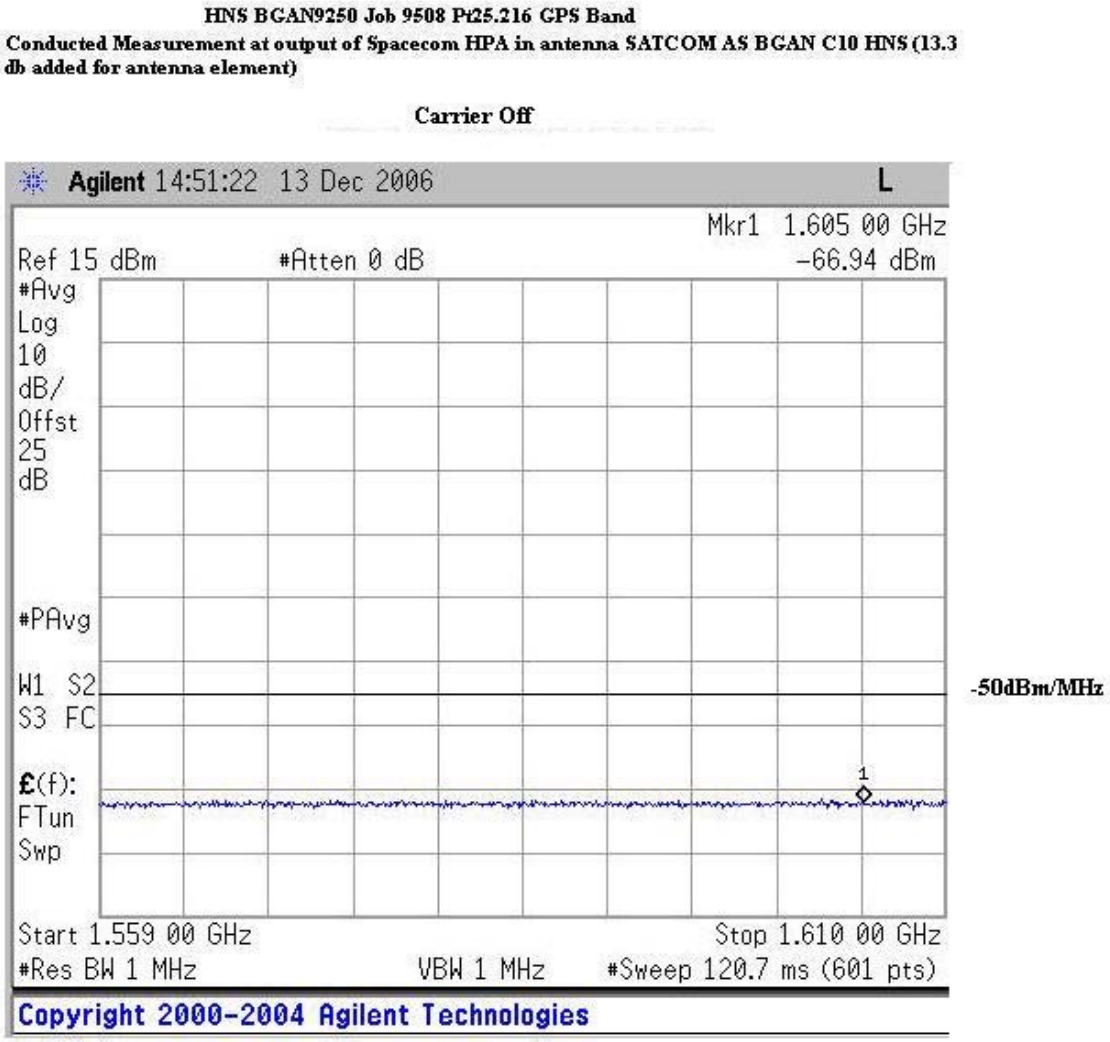


Figure 71: GPS Band Emissions, Carrier Off

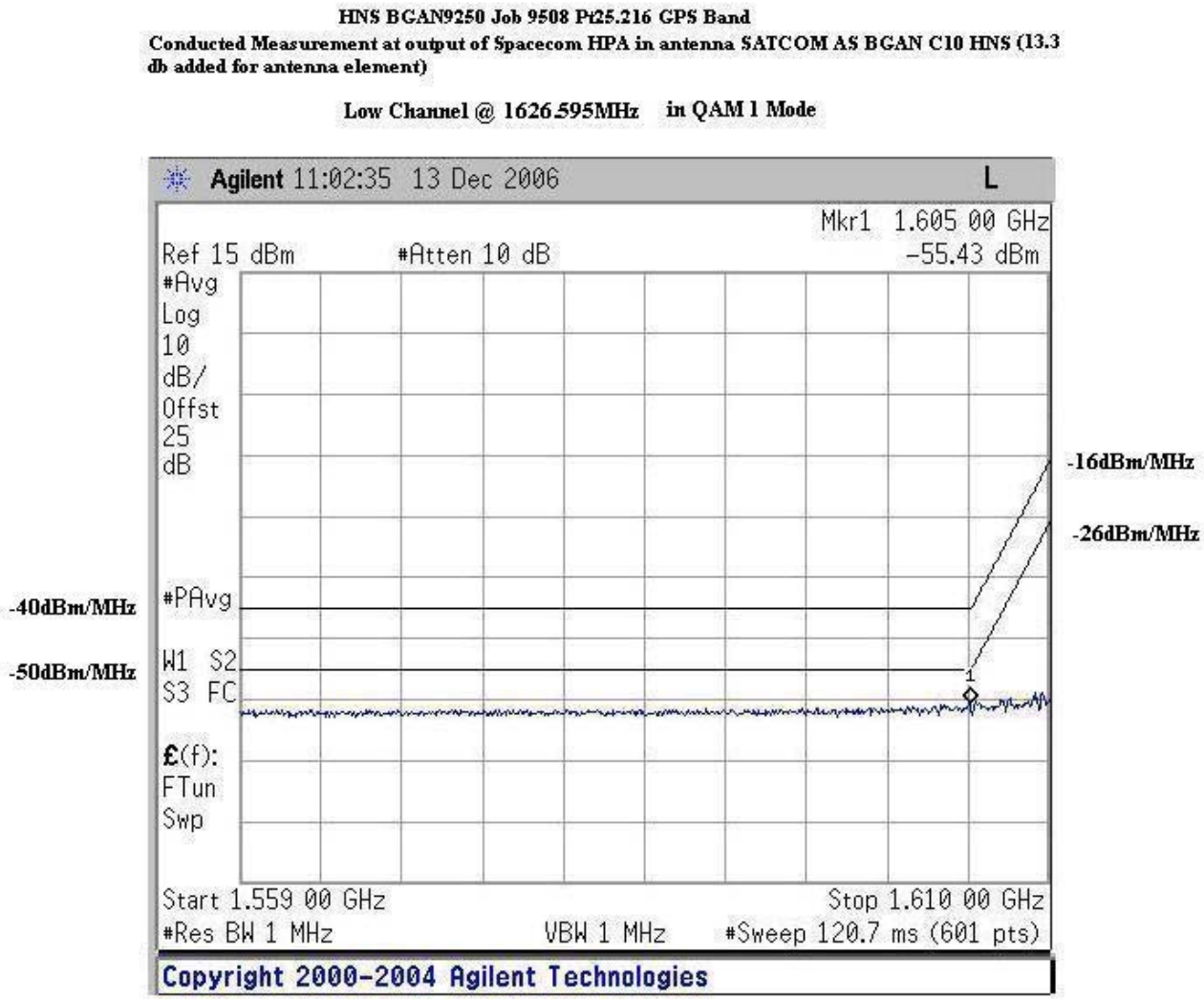


Figure 73: GPS Band Emissions, QAM 1 Low Channel

HNS BGAN9250 Job 9508 Pt25.216 GPS Band
Conducted Measurement at output of Spacecom HPA in antenna SATCOM AS BGAN C10 HNS (13.3 db added for antenna element)

Center channel @ 1643.6MHz in QAM 1 Mode

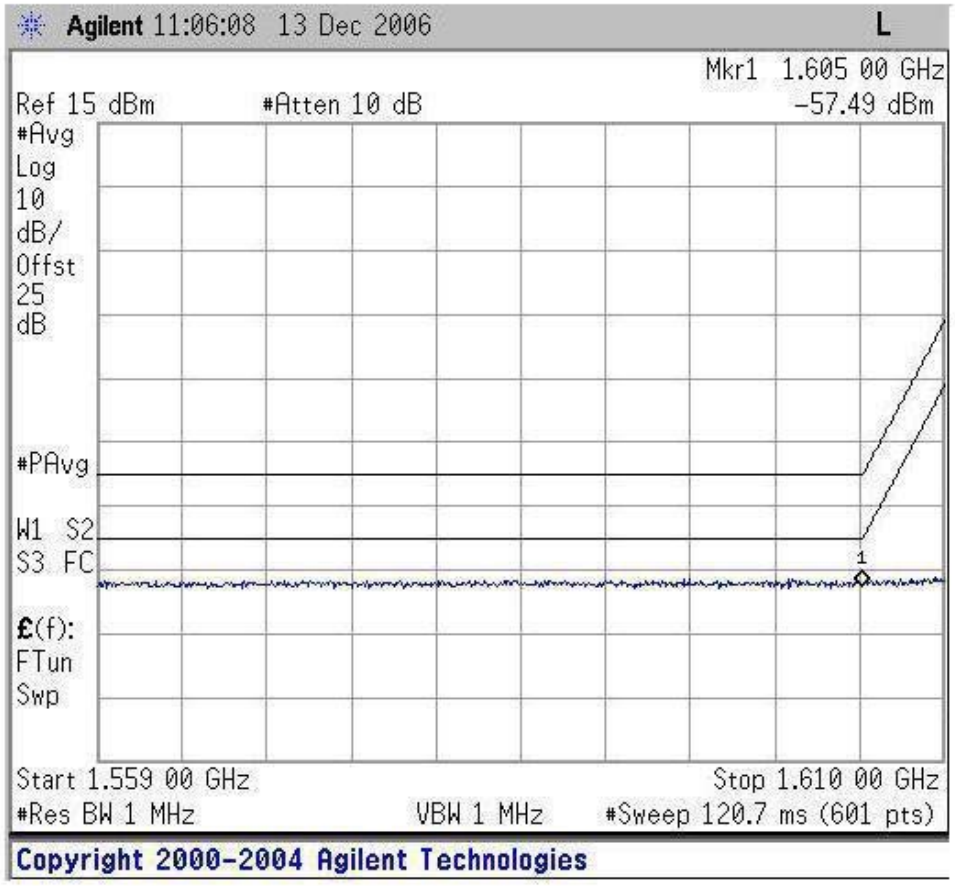


Figure 74: GPS Band Emissions, QAM 1 Mid Channel

HNS BGAN9250 Job 9508 Pt25.216 GPS Band
Conducted Measurement at output of Spacecom HPA in antenna SATCOM AS BGAN C10 HNS (13.3 db added for antenna element)

High Channel @ 1660.405MHz in QAM 1 Mode

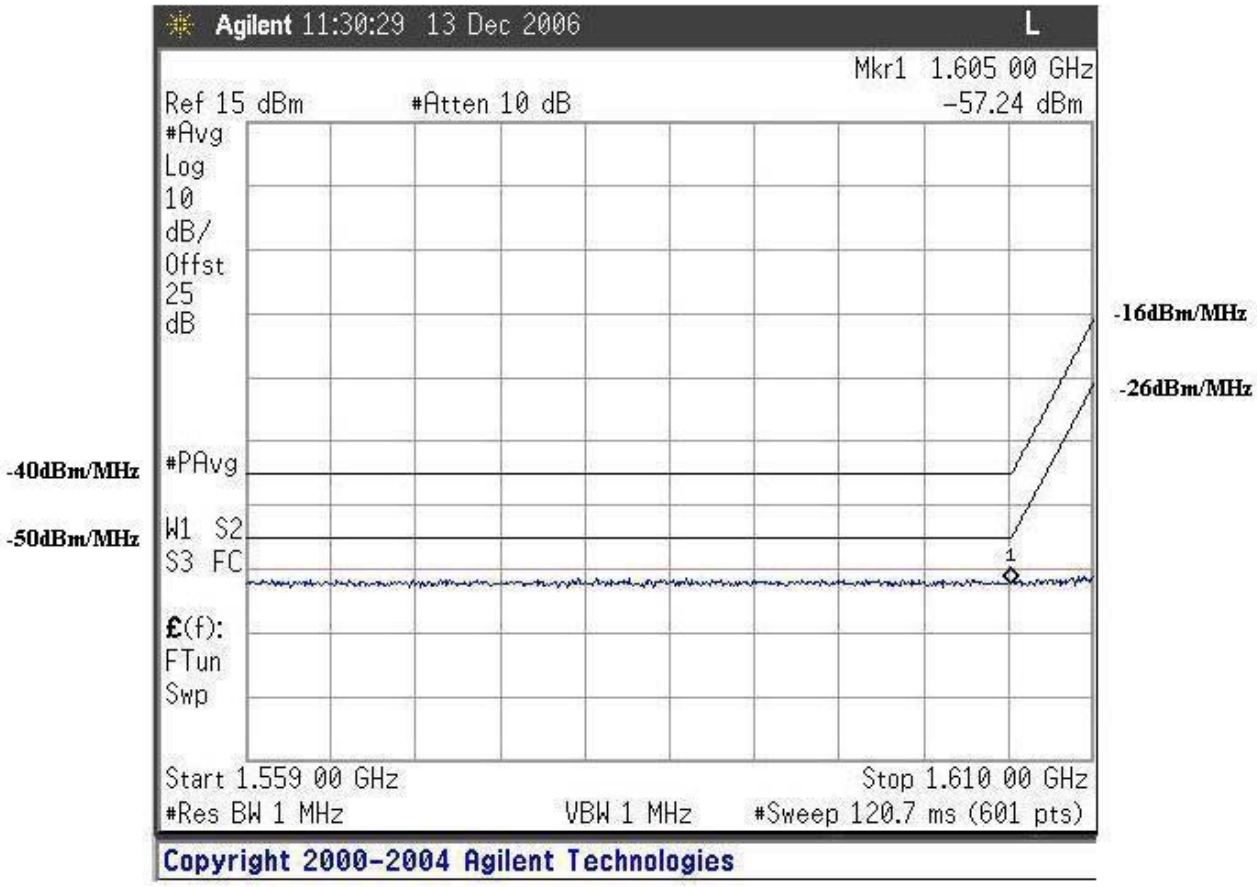


Figure 74: GPS Band Emissions, QAM 1 High Channel

HNS BGAN9250 Job 9508 Pt25.216 GPS Band
Conducted Measurement at output of Spacecom HPA in antenna SATCOM AS BGAN C10 HNS (13.3 db added for antenna element)

Low Channel @ 1626.595MHz in QAM 2 Mode

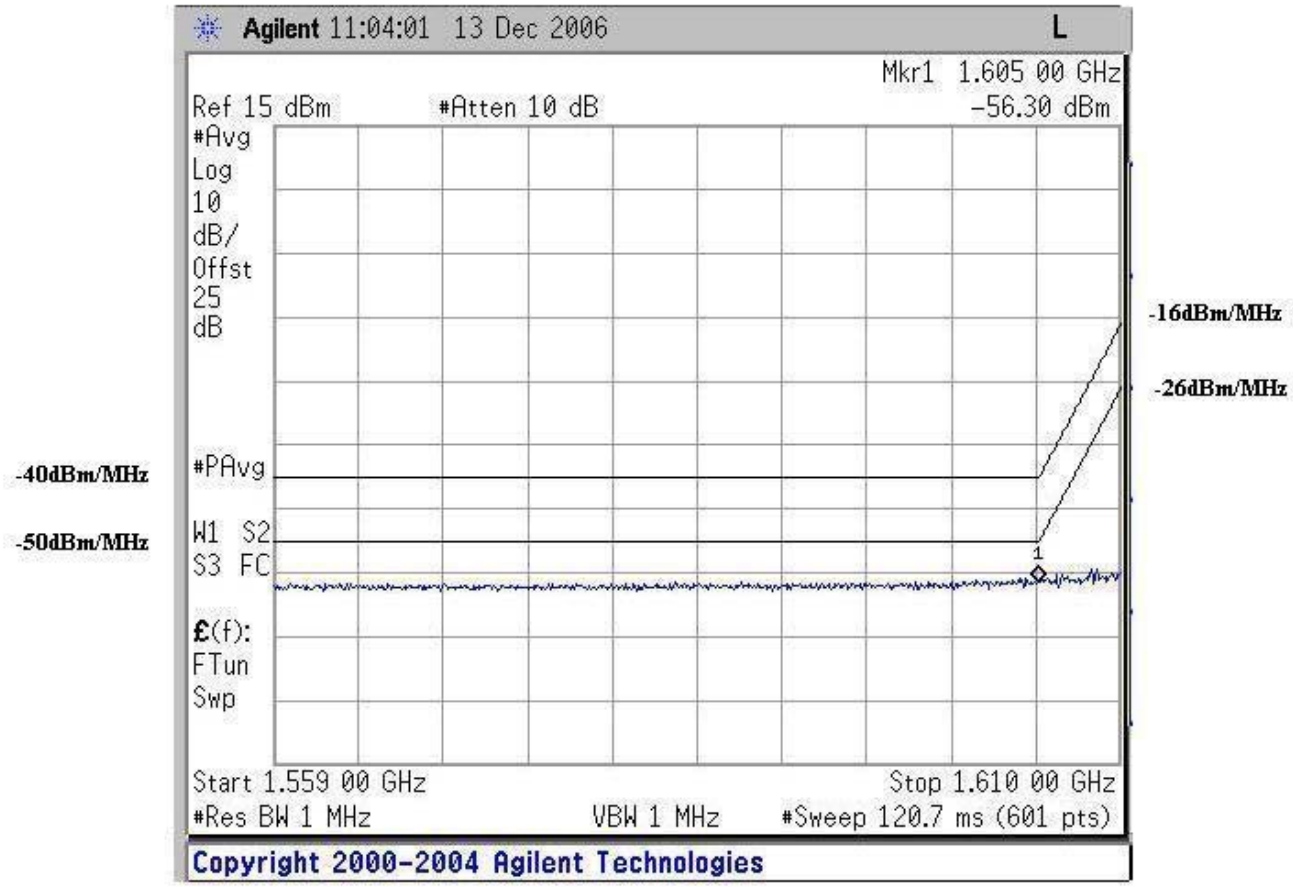


Figure 76. GPS Band Emissions, QAM 2 Low Channel

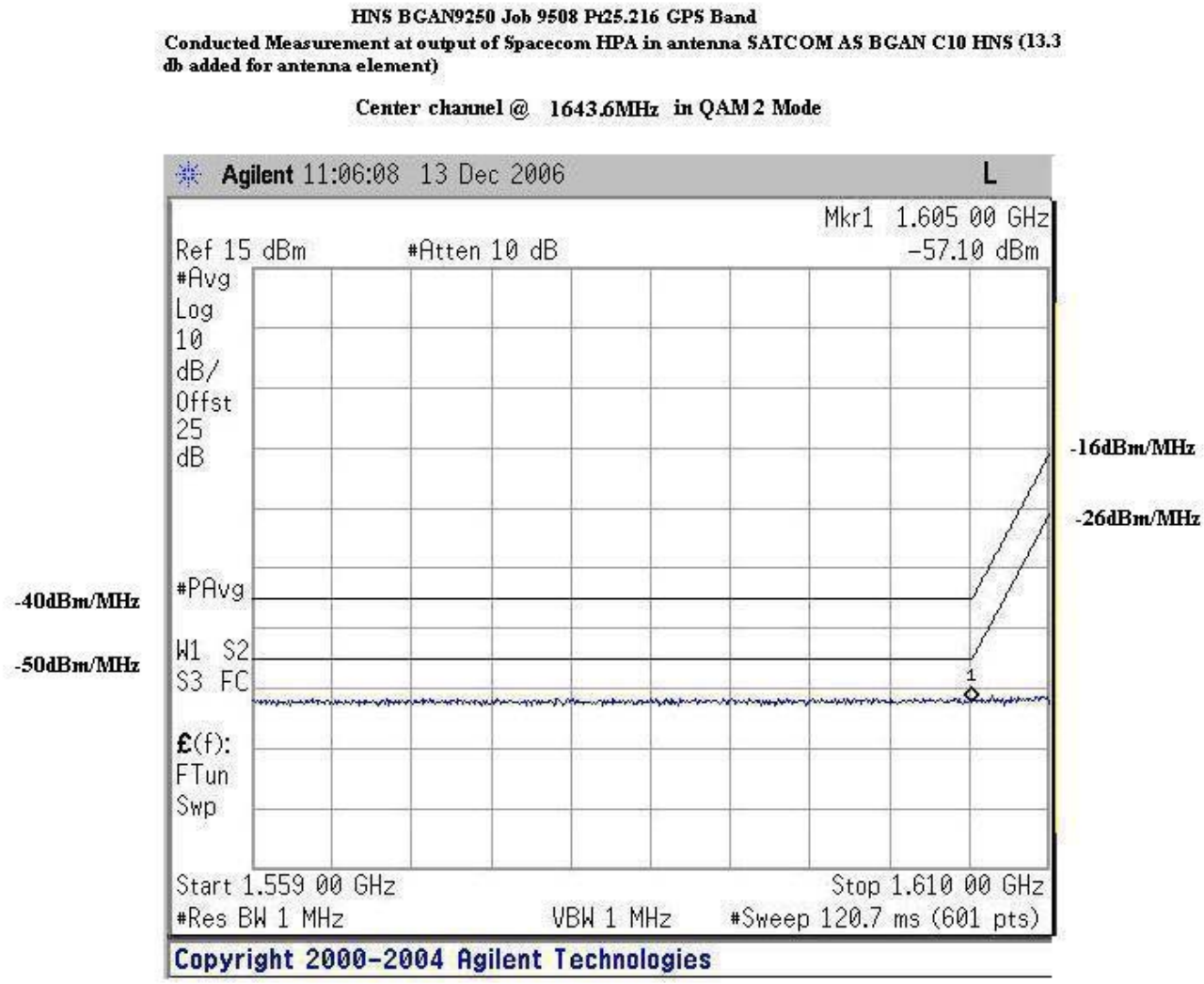


Figure 77. GPS Band Emissions, QAM 2 Mid Channel

HNS BGAN9250 Job 9508 Pt25.216 GPS Band
Conducted Measurement at output of Spacecom HPA in antenna SATCOM AS BGAN C10 HNS (13.3 db added for antenna element)

High Channel @ 1660.405MHz in QAM 2 Mode

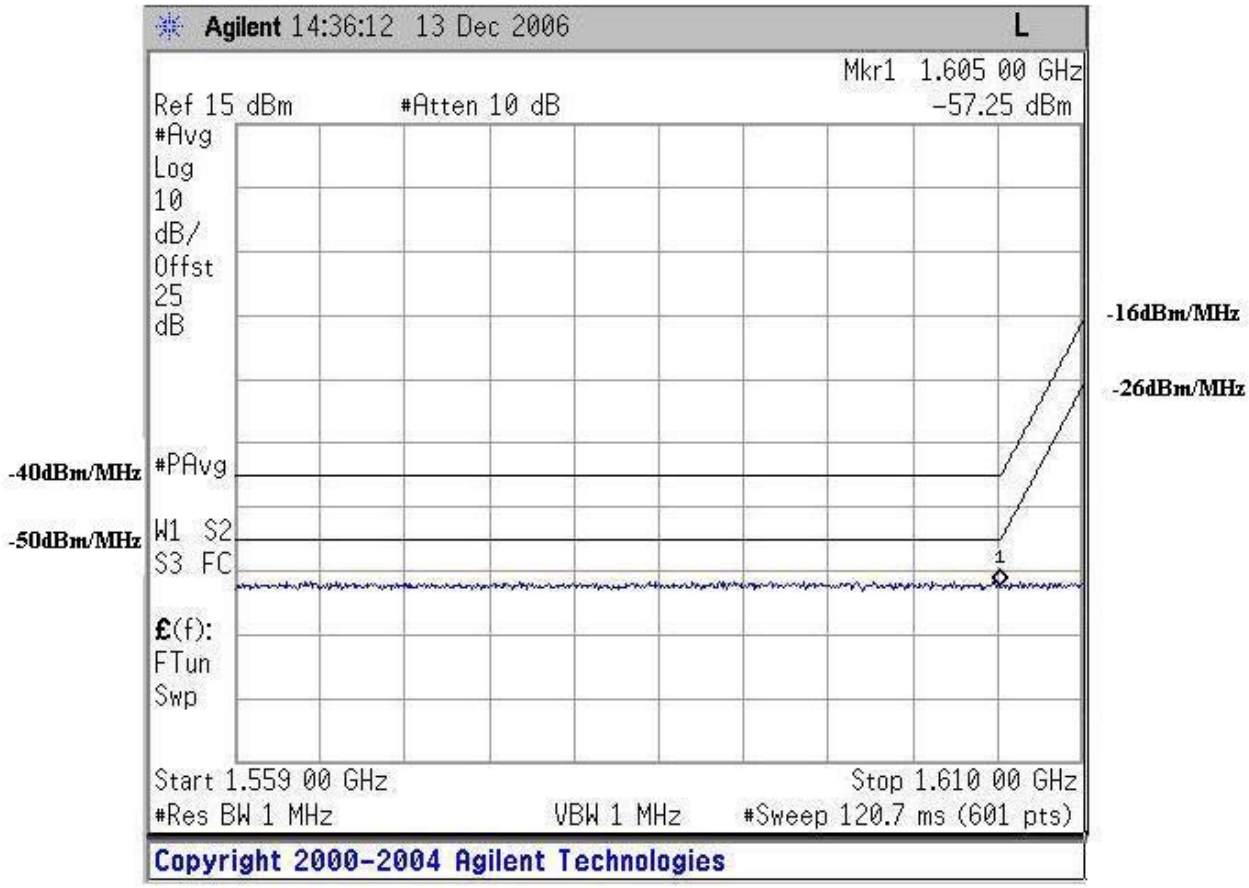


Figure 78. GPS Band Emissions, QAM 2 High Channel

HNS BGAN9250 Job 9508 Pt25.216 GPS Band
Conducted Measurement at output of Spacecom HPA in antenna SATCOM AS BGAN C10 HNS (13.3 db added for antenna element)

Low Channel @ 1626.595MHz in QAM 4.5 Mode

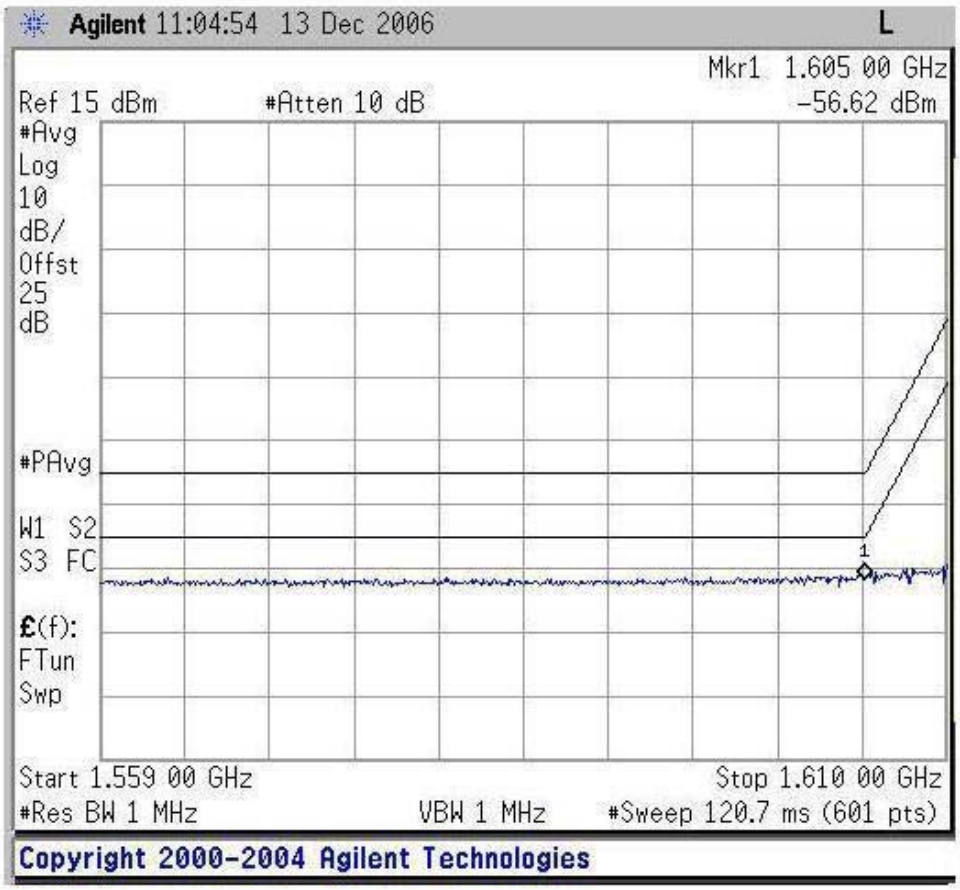


Figure 79. GPS Band Emissions, QAM 4.5 Low Channel

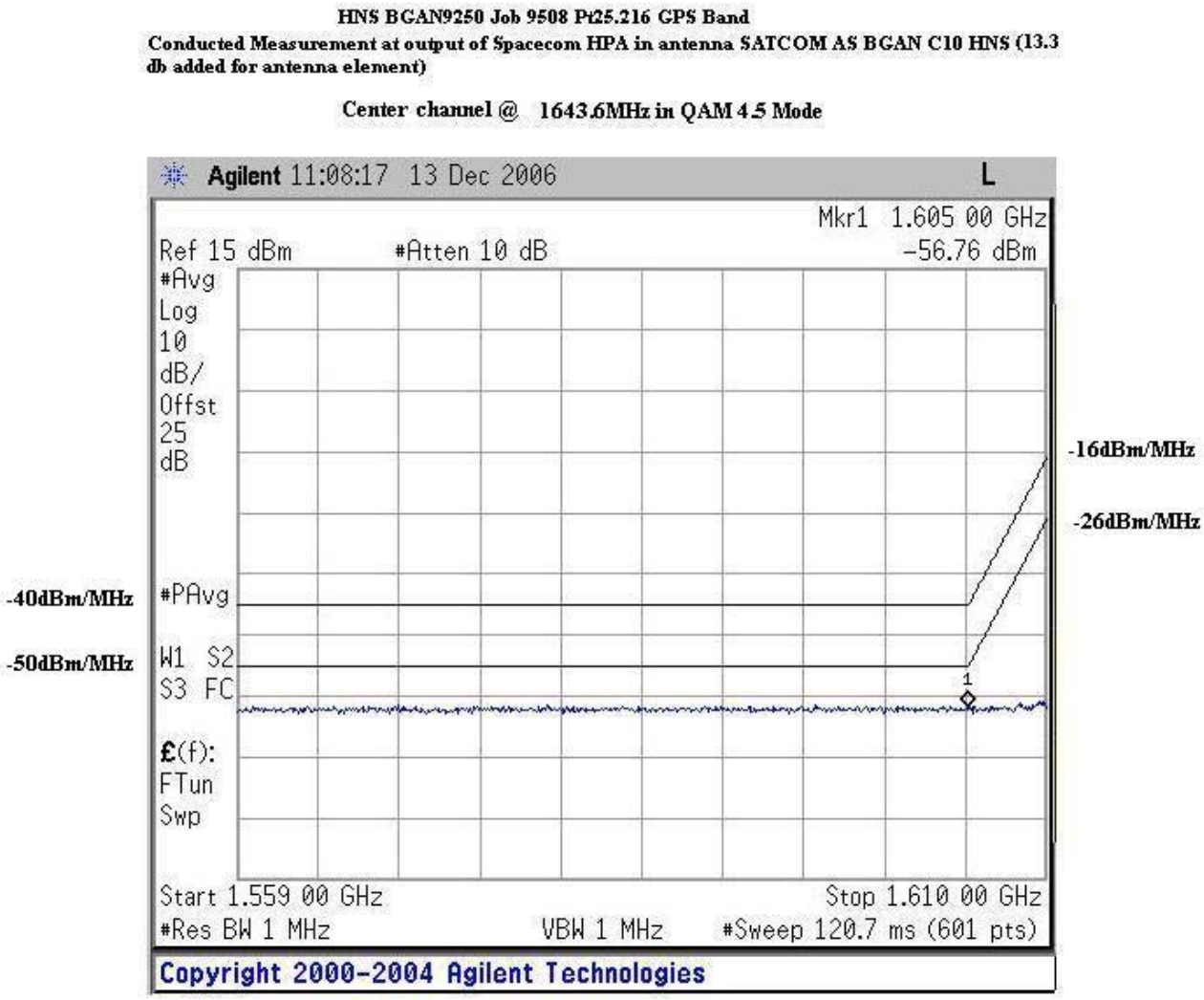


Figure 80. GPS Band Emissions, QAM 4.5 Mid Channel

HNS BGAN9250 Job 9508 Pt25.216 GPS Band
Conducted Measurement at output of Spacecom HPA in antenna SATCOM AS BGAN C10 HNS (13.3 db added for antenna element)

High Channel @ 1660.405MHz in QAM4.5 Mode

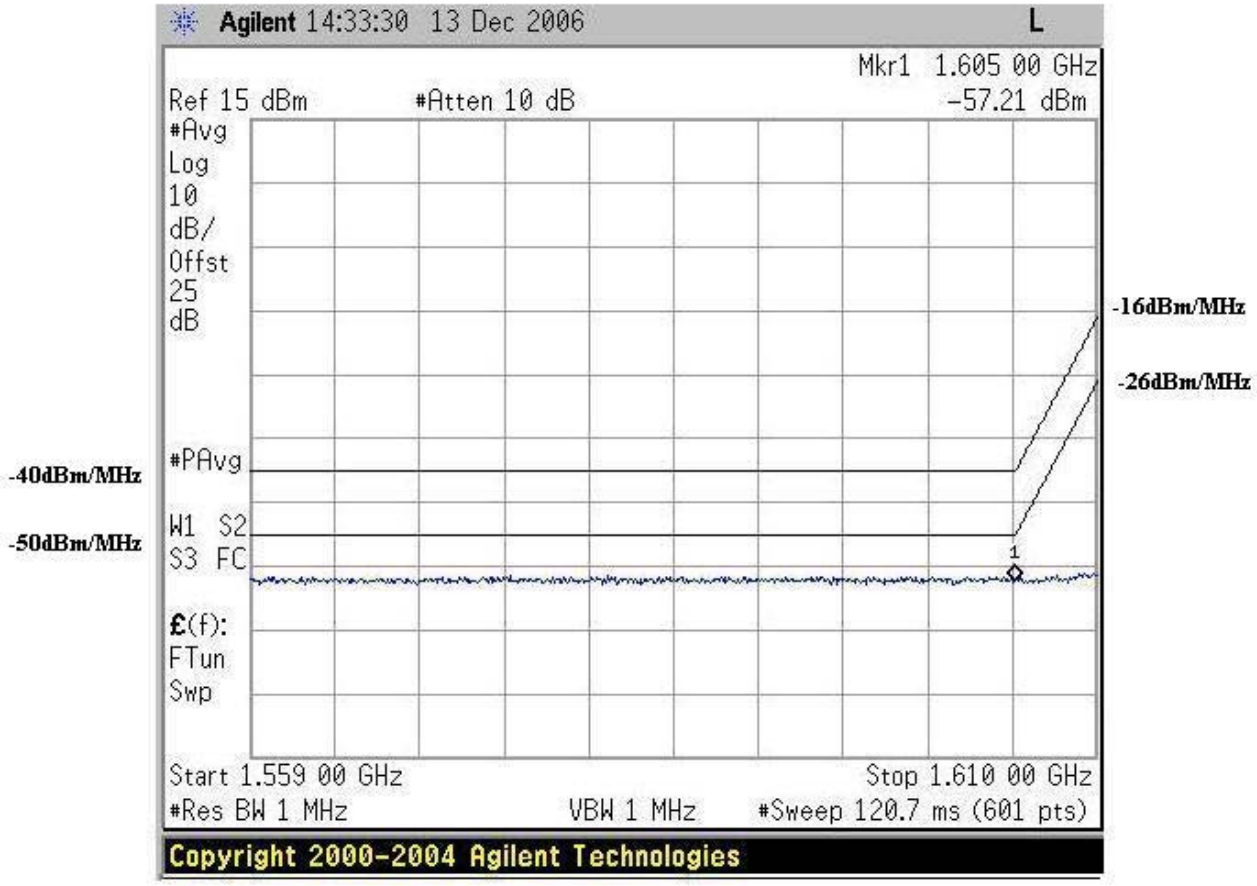


Figure 81. GPS Band Emissions, QAM 4.5 High Channel

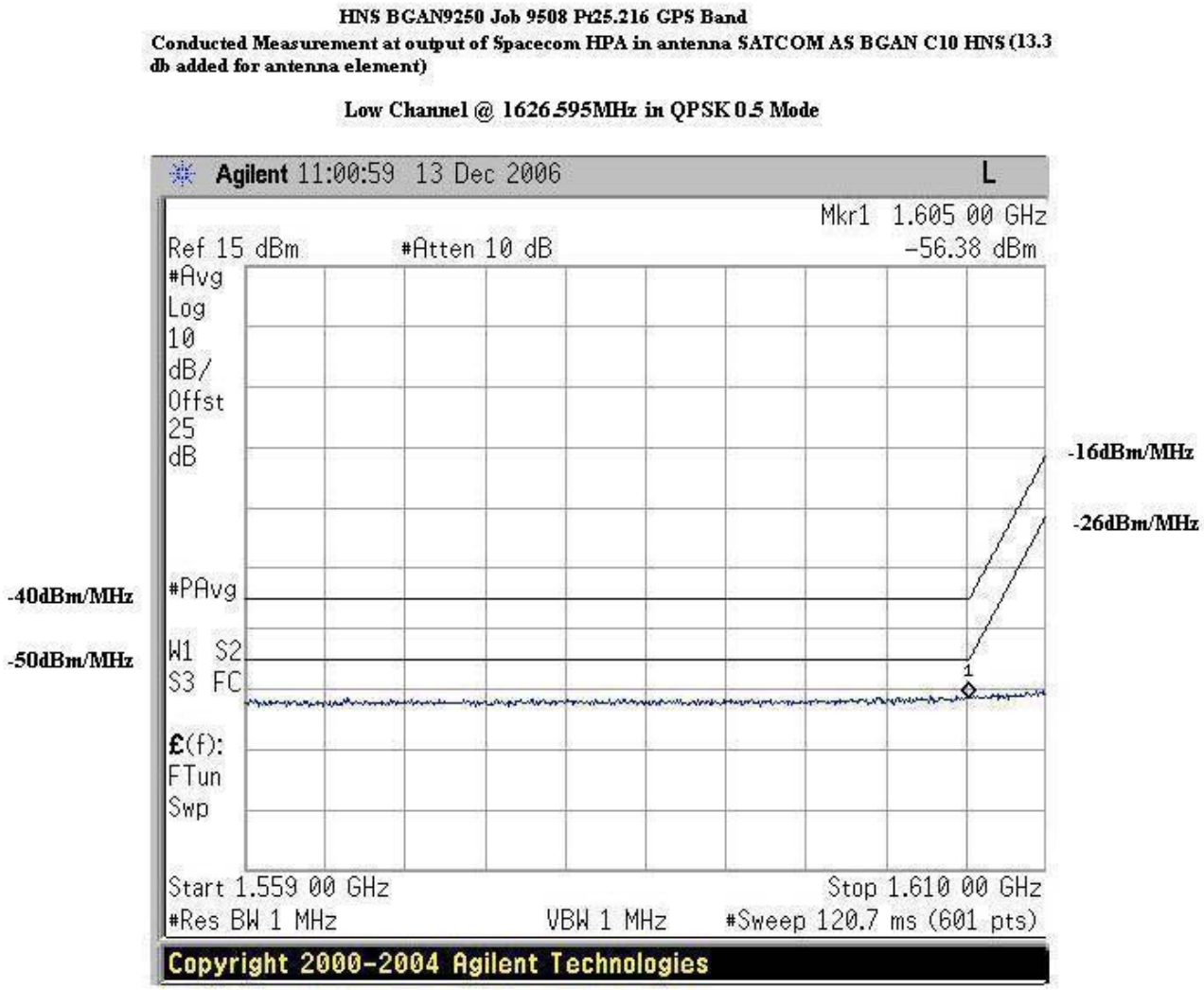


Figure 82. GPS Band Emissions, QPSK 0.5 Low Channel

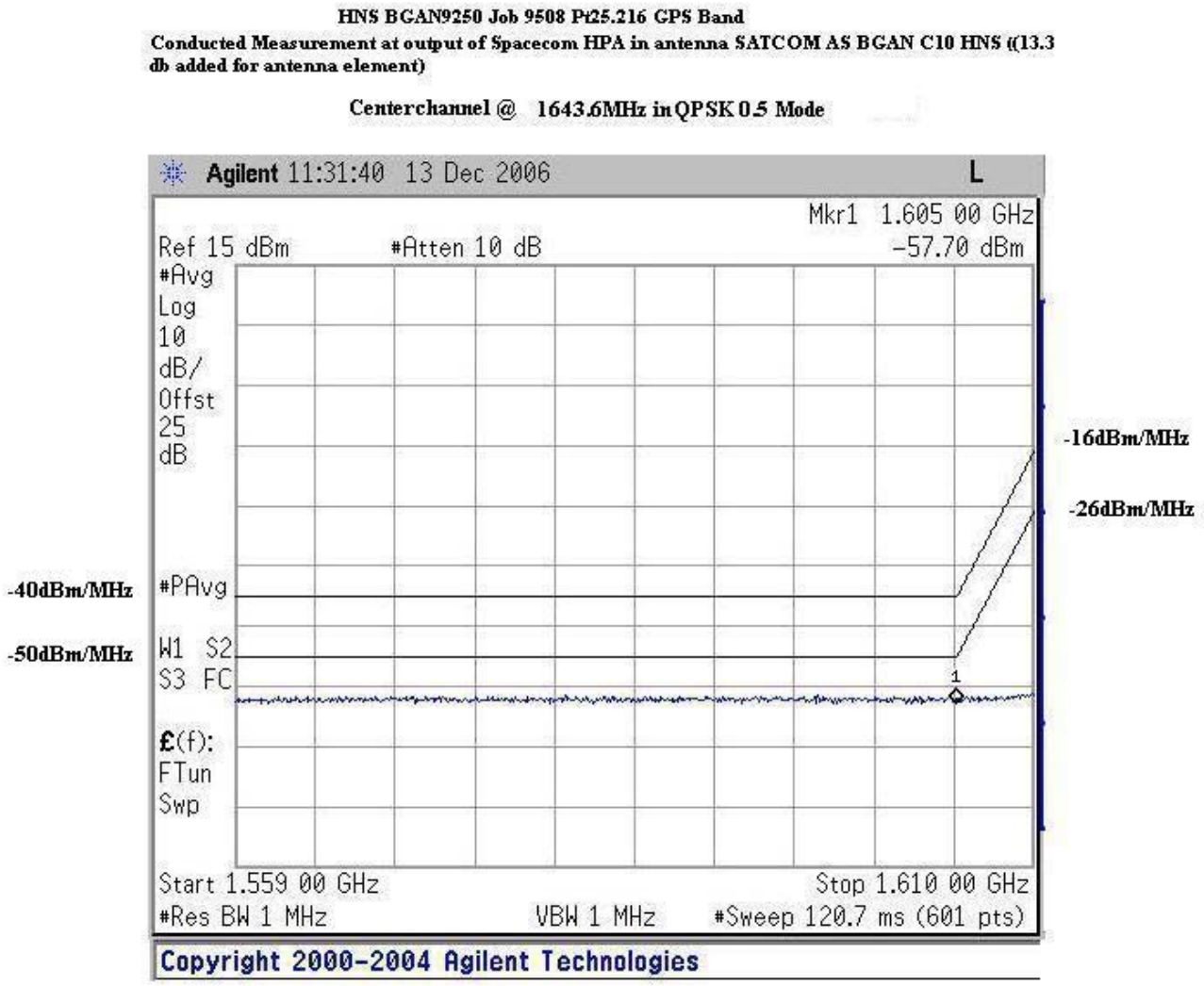


Figure 83. GPS Band Emissions, QPSK 0.5 Mid Channel

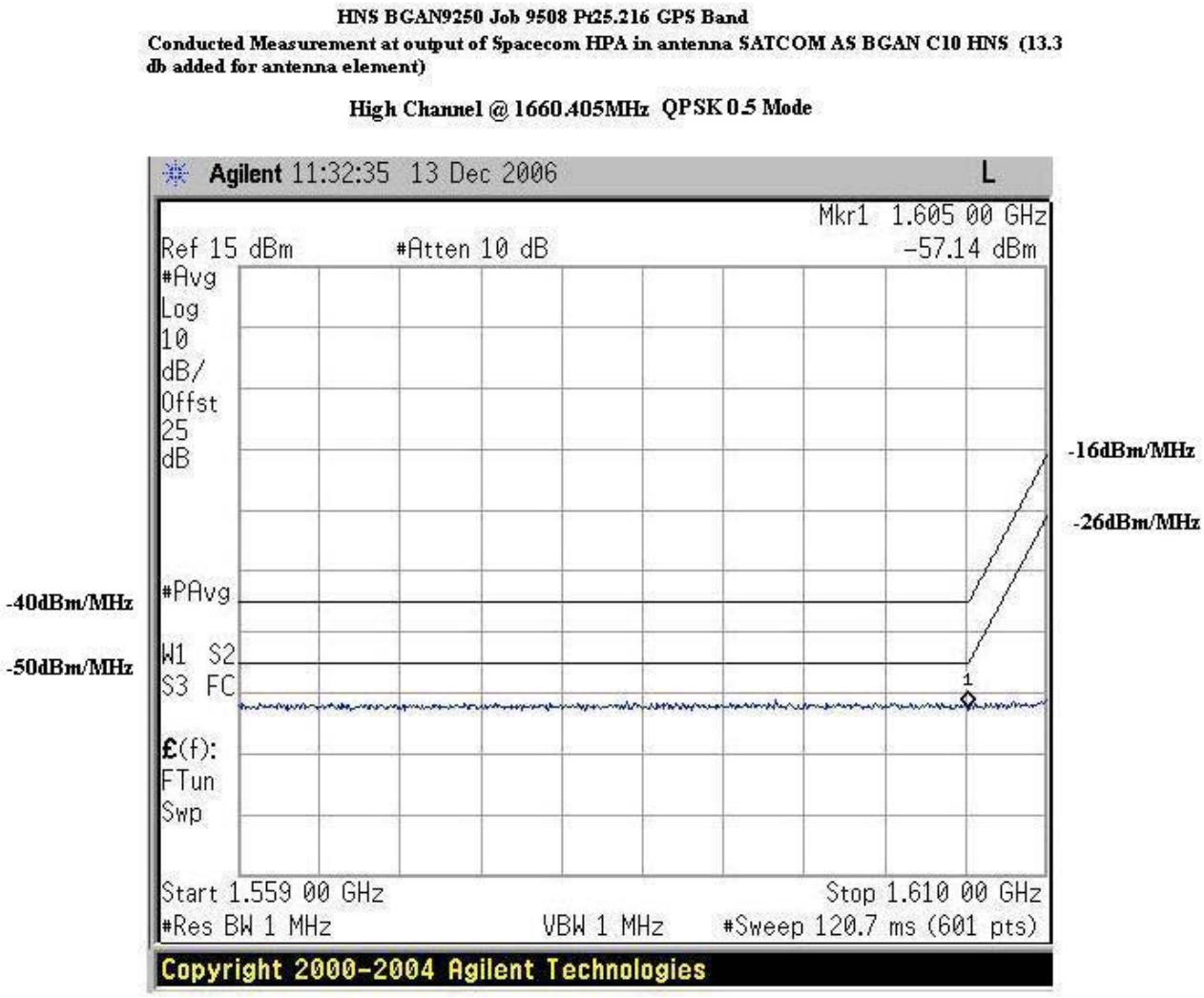


Figure 84. GPS Band Emissions, QPSK 0.5 High Channel

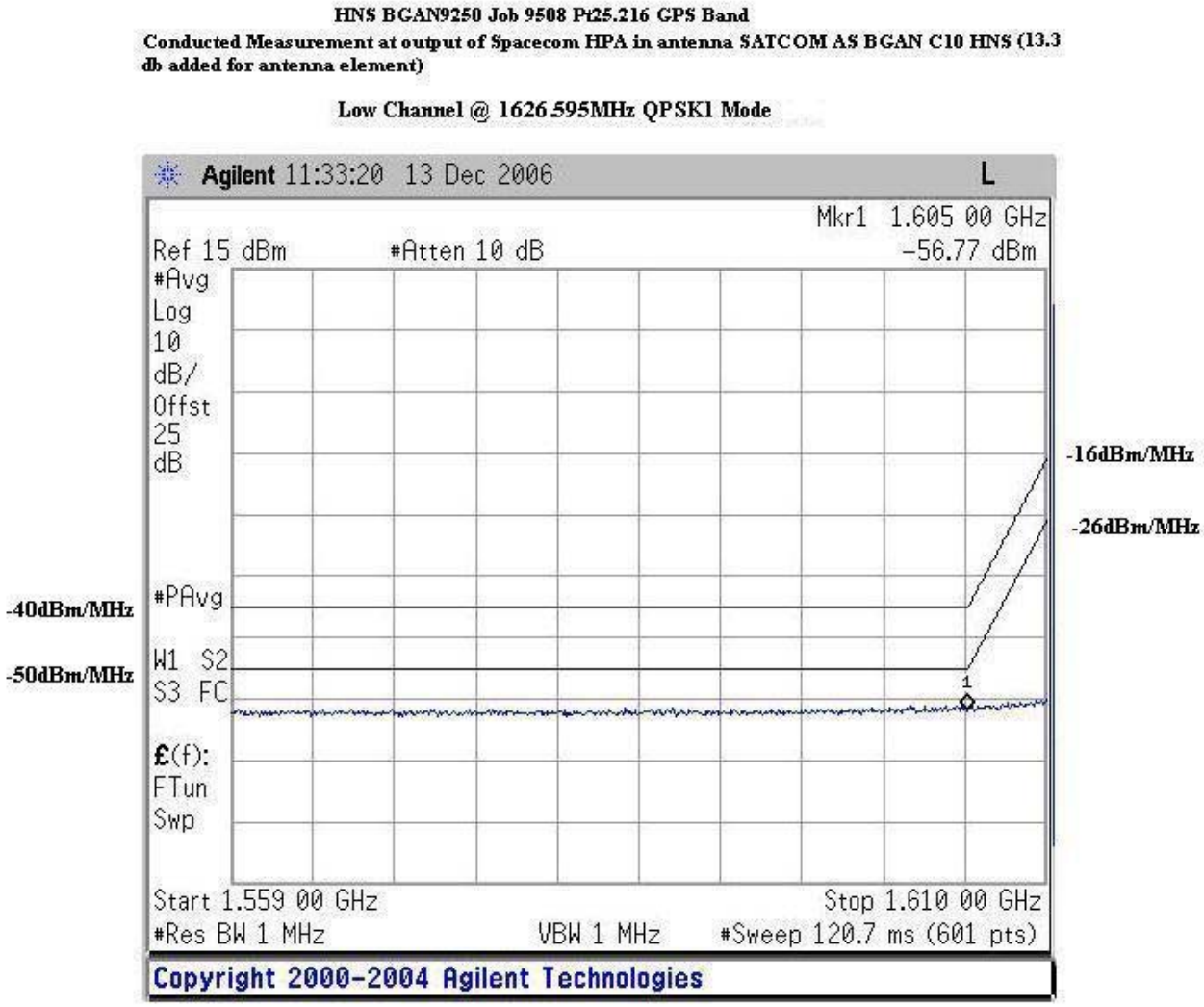


Figure 85. GPS Band Emissions, QPSK 1 Low Channel

HNS BGAN9250 Job 9508 Pt25.216 GPS Band
Conducted Measurement at output of Spacecom HPA in antenna SATCOM AS BGAN C10 HNS (13.3 db added for antenna element)

Center channel @ 1643.6MHz in QPSK 1 Mode

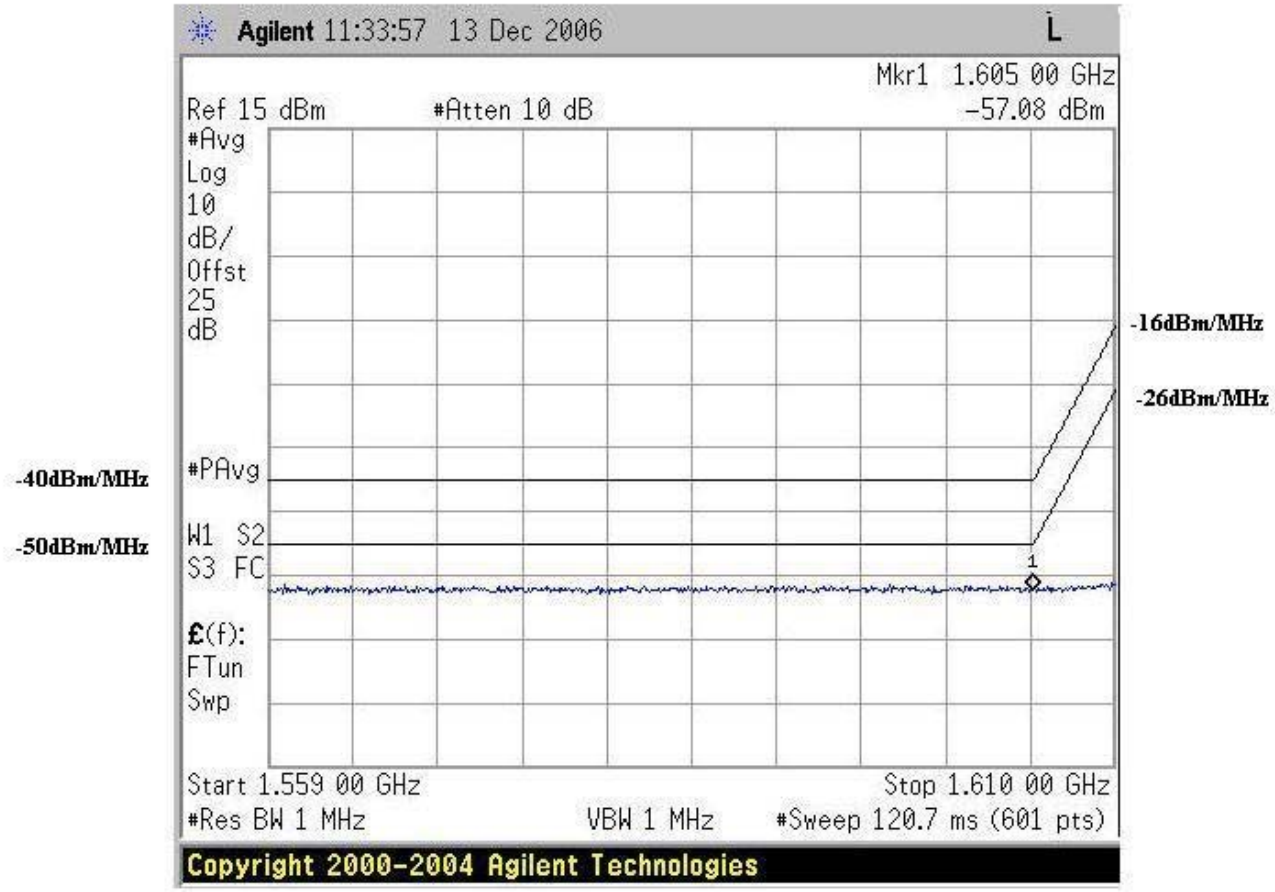


Figure 86. GPS Band Emissions, QPSK 1 Mid Channel

HNS BGAN9250 Job 9508 Pt25.216 GPS Band
Conducted Measurement at output of Spacecom HPA in antenna SATCOM AS BGAN C10 HNS (13.3 db added for antenna element)

High Channel @ 1660.405MHz in QPSK 1 Mode

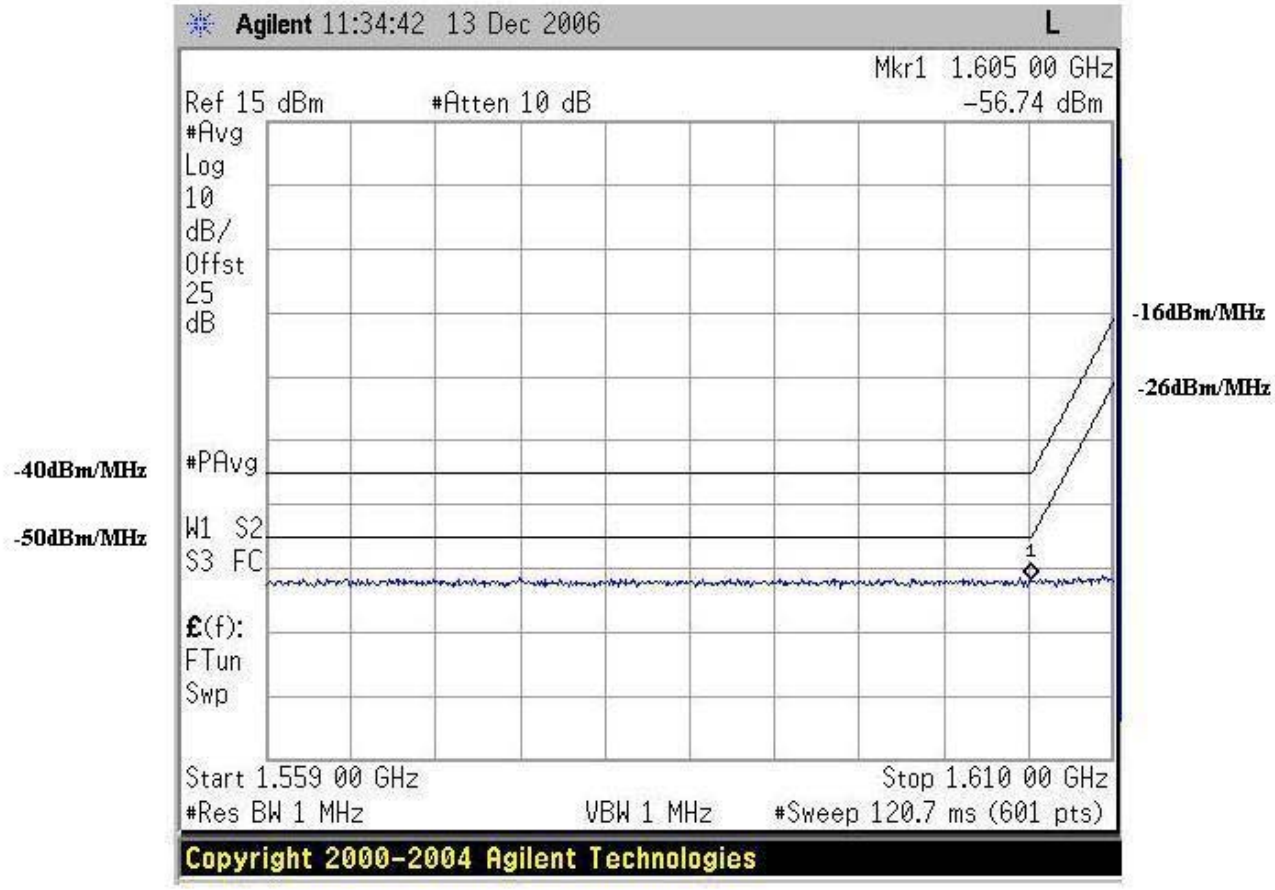


Figure 87. GPS Band Emissions, QPSK 1 High Channel

HNS BGAN9250 Job 9508 Pt25.216 GPS Band
Conducted Measurement at output of Spacecom HPA in antenna SATCOM AS BGAN C10 HNS (13.3 db added for antenna element)

Low Channel @ 1626.595MHz in QPSK 2 Mode

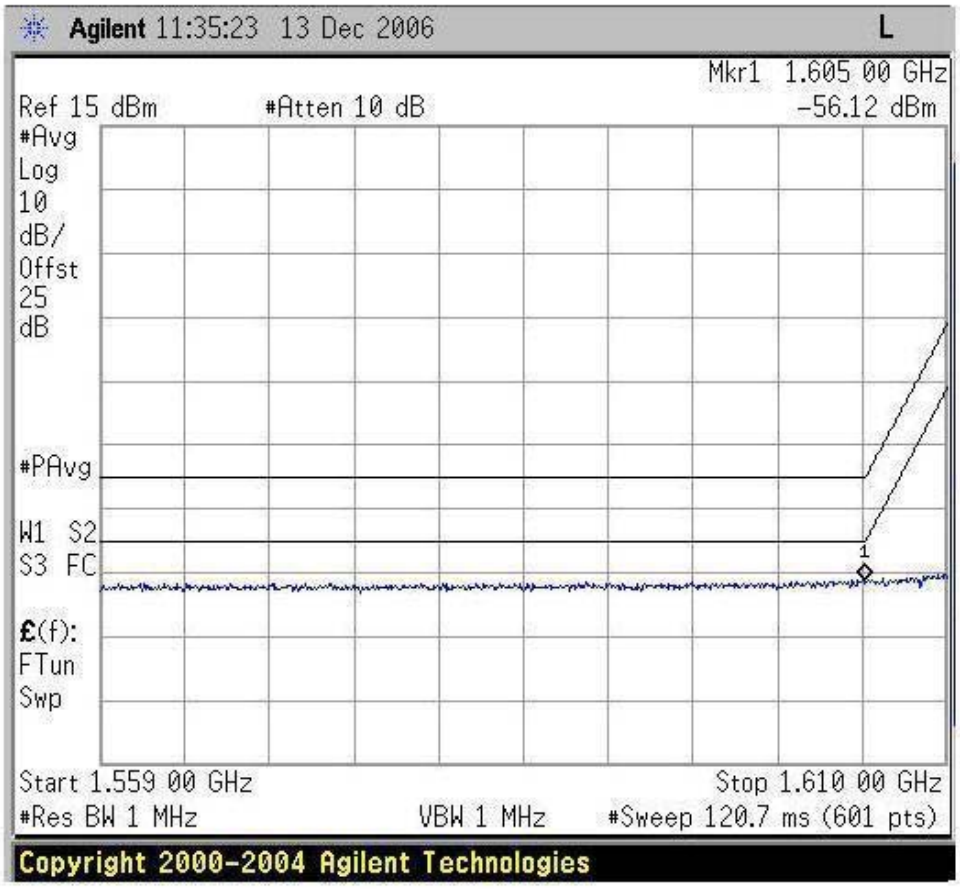


Figure 88. GPS Band Emissions, QPSK 2 Low Channel

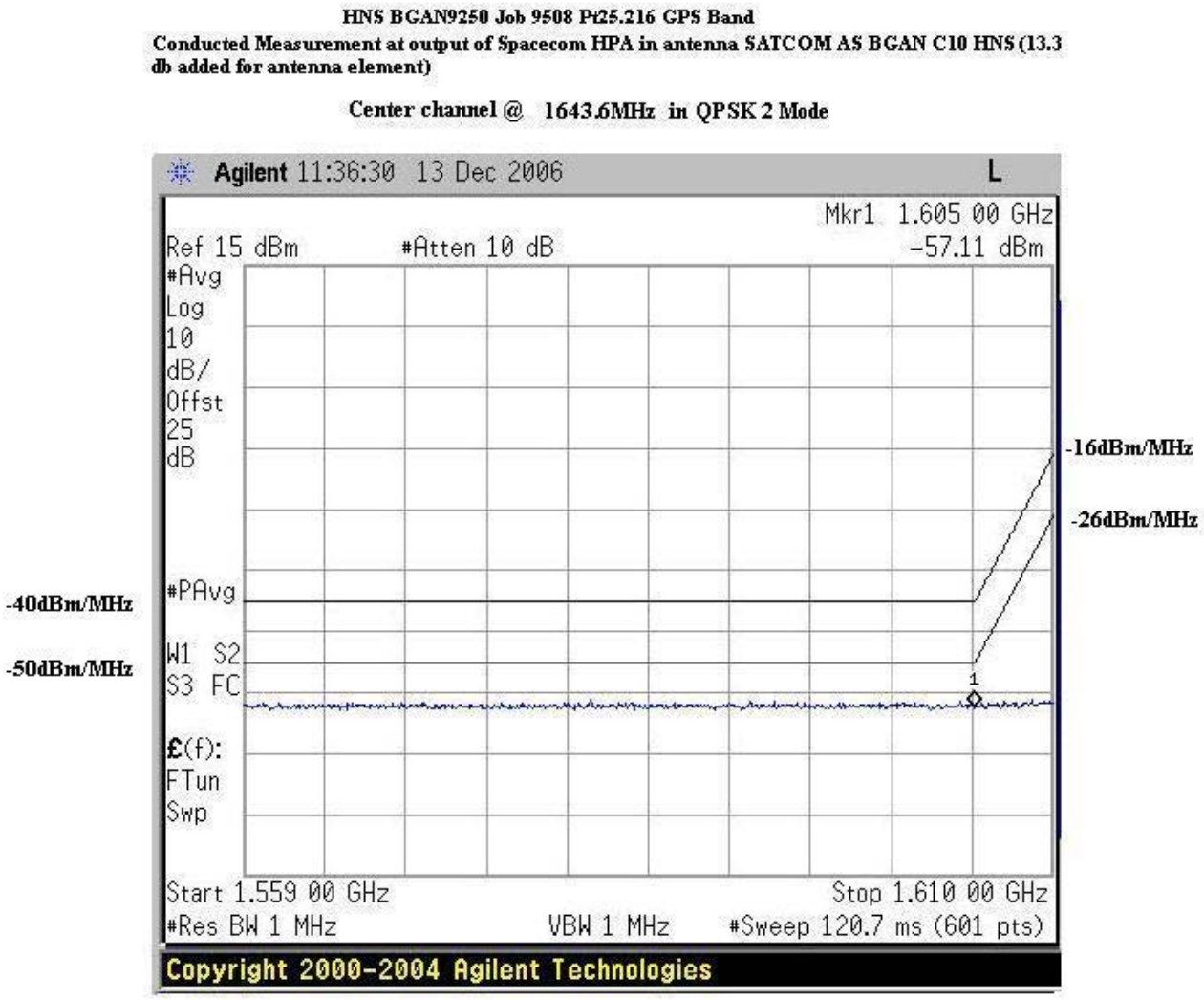
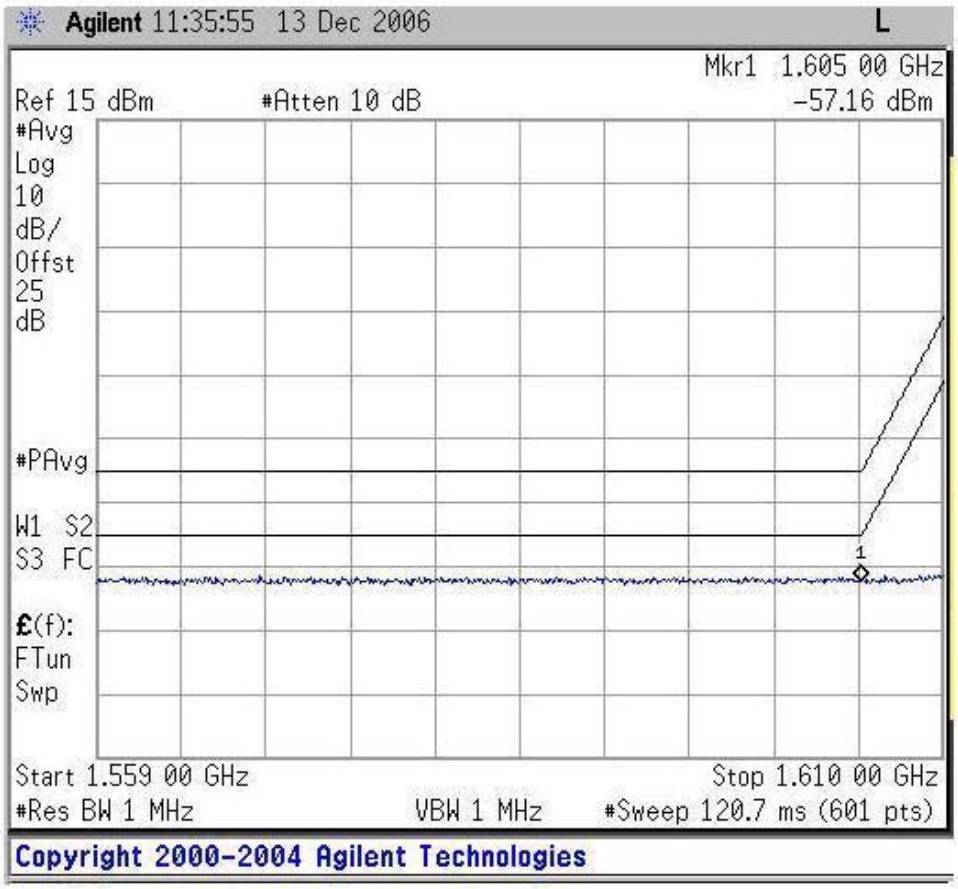


Figure 89. GPS Band Emissions, QPSK 2 Mid Channel

HNS BGAN9250 Job 9508 Pt25.216 GPS Band
Conducted Measurement at output of Spacecom HPA in antenna SATCOM AS BGAN C10 HNS (13.3 db added for antenna element)

High Channel @ 1660.405MHz in QPSK 2 Mode



-16dBm/MHz

-26dBm/MHz

-40dBm/MHz

-50dBm/MHz

Figure 90. GPS Band Emissions, QPSK 2 High Channel

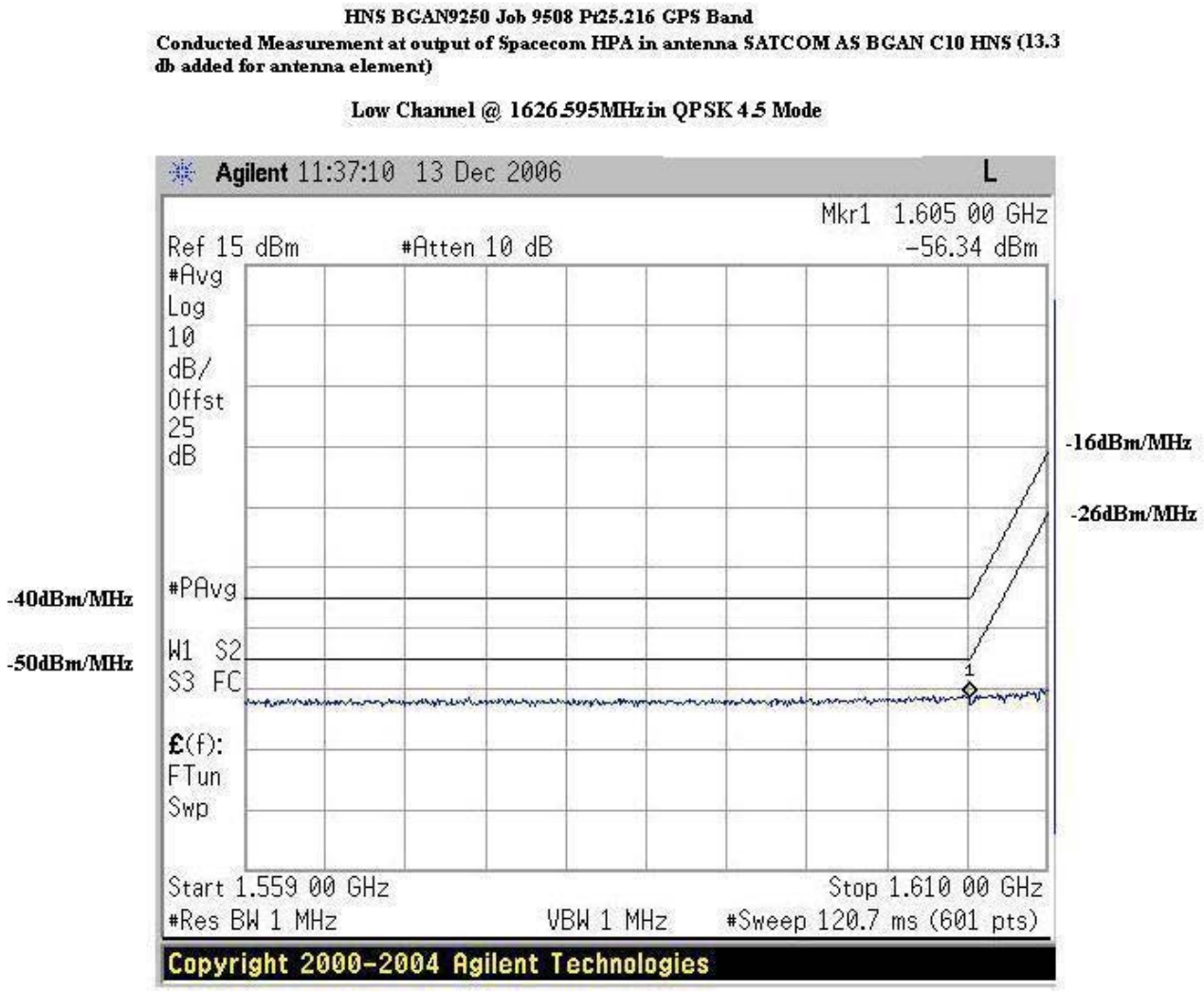


Figure 91. GPS Band Emissions, QPSK 4.5 Low Channel

HNS BGAN9250 Job 9508 Pt25.216 GPS Band
Conducted Measurement at output of Spacecom HPA in antenna SATCOM AS BGAN C10 HNS (13.3 db added for antenna element)

Center channel @ 1643.6MHz in QPSK 4.5 Mode

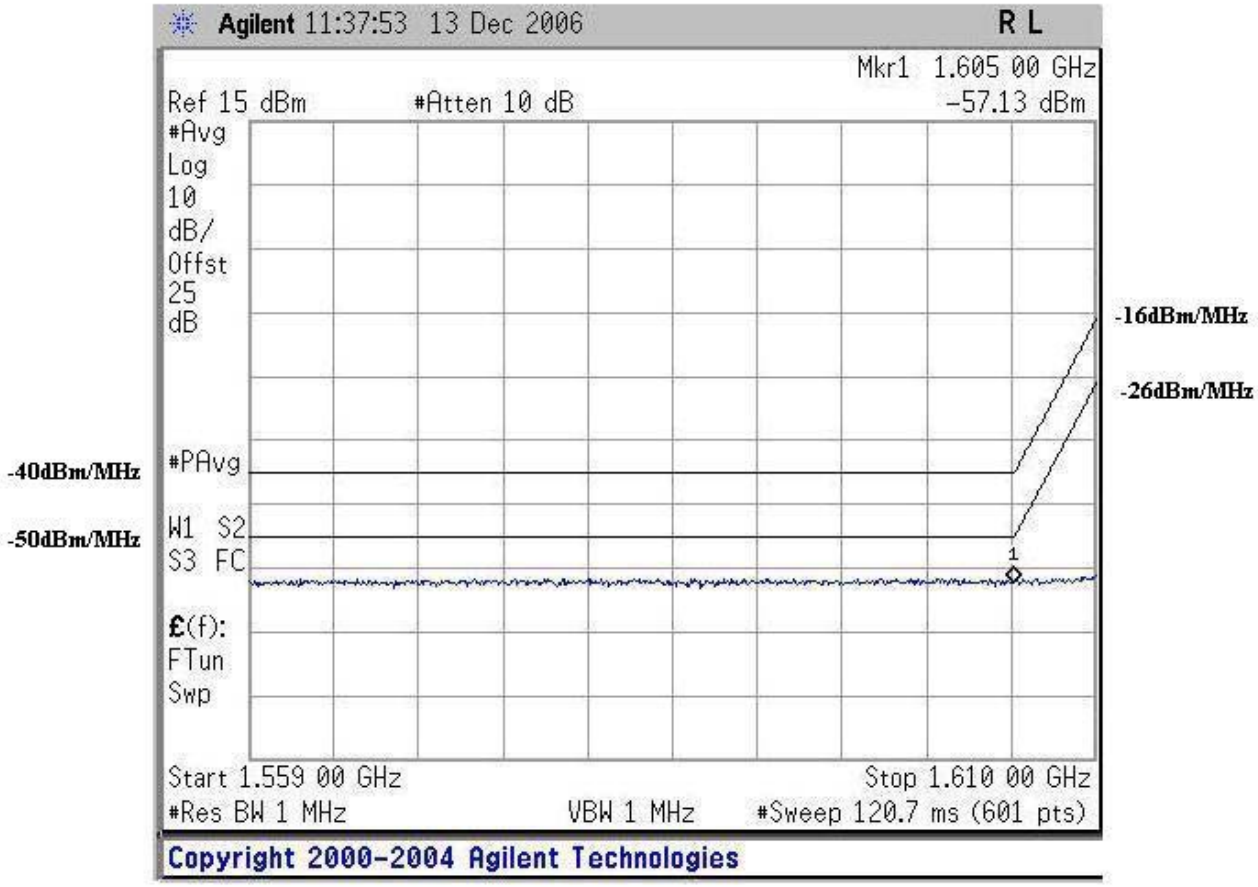


Figure 92. GPS Band Emissions, QPSK 4.5 Mid Channel

HNS BGAN9250 Job 9508 Pt25.216 GPS Band
Conducted Measurement at output of Spacecom HPA in antenna SATCOM AS BGAN C10 HNS (13.3 db added for antenna element)

High Channel @ 1660.405MHz in QPSK 4.5MOde

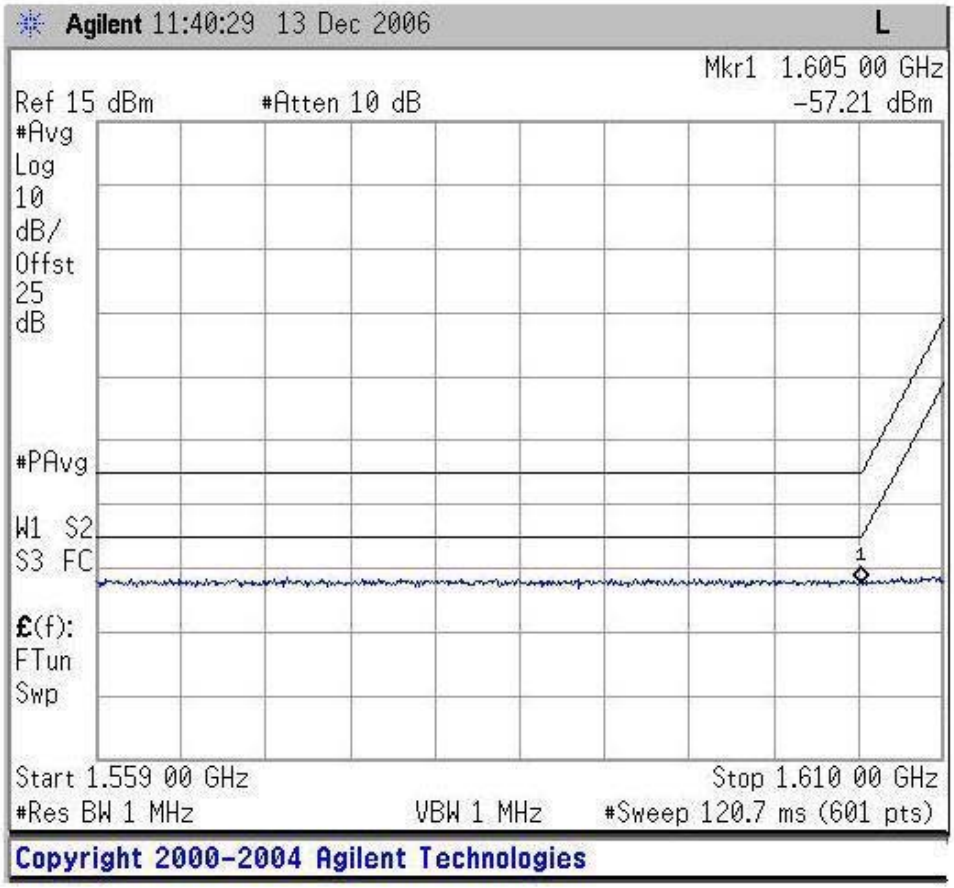


Figure 93. GPS Band Emissions, QPSK 4.5 High Channel

4.6 Frequency Stability: (FCC Part §2.1055)

Frequency as a function of temperature and voltage variation shall be maintained within the FCC-prescribed tolerances. Per §25.202(d) the frequency tolerance shall be maintained within 0.001% of the reference frequency.

4.6.1 Test Procedure

The temperature stability was measured with the unit in an environmental chamber used to vary the temperature of the sample. The sample was held at each temperature step to allow the temperature of the sample to stabilize.

The frequency stability of the transmitter was examined at the voltage extremes and for the temperature range of -30°C to +50°C. The carrier frequency was measured while the EUT was in the temperature chamber. The reference frequency of the EUT was measured at the ambient room temperature with the frequency counter.

The frequency stabilities can be maintained to a lesser temperature range provided that the transmitter is automatically inhibited from operating outside the lesser temperature range.

The RF carrier frequency shall not depart from the reference frequency (reference frequency is the frequency at 20ºC and rated supply voltage) in excess of +/-16436 Hz.

The EUT is powered by 13Vdc voltage supplied via an external DC power supply.

4.6.2 Test Results

The EUT complies with the temperature stability requirements of FCC §25.202. Test results are given in Table 7.

Table 7: Frequency Stability Test Data

Temperature (Centigrade)	Frequency (MHz)	Difference (Hz)	Deviation (%)
Ambient	1643.600218	0.0	0
-30	1643.598827	-1391.0	0.000085
-20	1643.599997	-221.0	0.000013
-10	1643.601189	971.0	0.000059
0	1643.601401	1183.0	0.000072
10	1643.601020	802.0	0.000049
20	1643.600868	650.0	0.000040
30	1643.599770	-448.0	0.000027
40	1643.599290	-928.0	0.000056
50	1643.598711	-1507.0	0.000092

Voltage (Volts)	Frequency (MHz)	Difference (Hz)	Deviation (%)	Voltage (Volts)
At rated	1643.599413	0	0.0	12.0 VDC
At 85%	1643.599469	-56	0.000003	10.2 VDC
At 115%	1643.599480	-67	0.000004	13.8 VDC

